AD-783 947

CYBERNETIC ANALYSIS OF A SIMULATED INTERNATIONAL THREAT SYSTEM: PRINCIPLES AND PROCEDURES

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Prepared for:

Office of Naval Research
Advanced Research Projects Agency

August 1974

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5285 Port Royal Road, Springfield Va. 22151

AD783947

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
1. REPORT NUMBER TR&A TECHNICAL PAPER #15	2. GOVT ACCESSION NO.	3. RECIPIENT'S CATALOG NUMBER
4. TITLE (and Subtitle) CYBERNETIC ANALYSIS OF A SIMULATED INTERNATIONAL THREAT SYSTEM: PRINCIPLES AND PROCEDURES		5. TYPE OF REPORT & PERIOD COVERED INTERIM TECHNICAL REPORT 5-74 to 8-74 6. PERFORMING ORG. REPORT NUMBER No. 15
7. AUTHOR(s) Richard Smith Beal		8. CONTRACT OR GRANT NUMBER(s) ARPA #2518 N00014-67-A-0269-0029
9. PERFORMING ORGANIZATION NAME AND ADDRESS Department of International Relations University of Southern California University Park, Los Angeles, CA 90007		10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS NR 177-952
11. CONTROLLING OFFICE NAME AND ADDRESS Organizational Effectiveness Research Office of Naval Research (Code 453) 800 Quincy St., Arlington, VA 22217		12. REPORT DATE August 1974 13. NUMBER OF PAGES 46
14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office)		15. SECURITY CLASS. (of this report) Unclassified 15a. DECLASSIFICATION/DOWNGRADING SCHEDULE

16. DISTRIBUTION STATEMENT (of this Report)

"Approved for public release; distribution unlimited"

17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report)

"Approved for public release; distribution unlimited"

18. SUPPLEMENTARY NOTES

19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Cybernetics, Simulation, Threat, Event-Interaction, Threat Recognition: Situational Threat, Synthetic Future, Systems Analysis, Control, Artificial Data

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

See the following page.

DD FORM 1 JAN 73 1473 EDITION OF 1 NOV 65 IS OBSOLETE
S/N 0102-014-6601

Unclassified

SECURITY CLASSIFICATION OF THIS PAGE (When Data Entered)

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Cybernetic Analysis of a Simulated International Threat System: Principles and Procedures

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TR&A Technical Report #15
Threat Recognition and Analysis Project

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Reproduction in whole or in part is permitted for any purpose of the United States Government. This research was sponsored by the Organizational Effectiveness Research Programs, Office of Naval Research (Code 452), under ARPA Contract No. #2518, N00014-67-A-0269-0029; NR 177-952.

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ABSTRACT

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Cybernetic Analysis of a Simulated International Threat System: Principles and Procedures

Introduction

Man, however crude, temporary and frail, is a fascinating object of scientific inquiry. He is the epitome of contradiction and inconsistency. He constructs and destroys, loves and hates, works and loafs; he is rational and irrational, sensitive and insensitive, wise and foolish. But no human quality is perhaps more fascinating than man's efforts to work against Clausius' second law of thermodynamics. According to its most modern form, the second law stipulates that the universe is breaking down structurally and running down dynamically. It is moving from an initial state of maximum order through successive, intermediate states of reduced order to a final state of disorder. This final state is a condition described by a uniform distribution of energy and information. It is a state of pure chaos, complete disorganization, total randomness. Man, as well as some other animate material systems, is one sector in the universe whose efforts directly oppose this disorganization tendency of the cosmos.

The principal strategy man employs to avert chaos and extend order is to capture and store the free energy and information in the environment. Once captured, energy and information are integrated into man's life support systems to sustain and upgrade the quality of life. They allow man to exert control over his environment, or portions thereof, and to constrain it in directions he deems appropriate. The biological aspect of this activity, which deals primarily with the energy side of the issue, is well documented and understood. Plants obtain energy from the sun's radiation which is transformed into organic compounds by photosynthesis. Animals, including man, receive energy from plants or from other animals. But this activity is not restricted to biological functions alone. In humans the processes of adjustment and adaptation to the environment (via energy and information) are conducted by somatological and extrasomatological mechanisms. Language, culture, tradition, belief structures, tools, industry, games, rituals, diplomacy, social norms, art, etc. are all manifestations of these extrasomatological mechanisms. The very fabric of society is woven by human processing of information and energy expenditure.

This total process is what Schrodinger called ". . . sucking orderliness from the environment . . . feeding on

negative entropy . . . ." (Schrodinger, 1944: 71-72) Man is particularly adroit at arresting the loss of energy and information. History is marked with his efforts to construct energy-conserving tools, and information processing systems. To facilitate this, man relies on his unique ability to express his environment symbolically in synthetic form. A convenient vehicle for this expression is a model. Models are designed to replicate the environment's essential behavior without permitting that behavior to be clouded by noise, clutter and distortions. Simplified, isolated, insulated and most importantly, accessible to man, the model is designed to generate the unadulterated behavior of the environment. This generation is unquestionably artifical and synthetic, but it is free from unmanageable variability and distortion. The model is crude in comparison to the environment. Even the most sophisticated models lack the richness of detail inherent in the environment, but they are also unencumbered by undue elaboration. Models are valuable if they accurately highlight the most salient behavioral regularities of the environment, and filter out the unnecessary variation which frequently encompasses the patterns of important, repetitive behavior.

Once formulated, man works with the model of the environment rather than the environment itself. The reason for this is obvious. The model is synthetic, man-made, and amendable to human manipulation. The environment, on the other hand, is more difficult to affect frontally. Its complexity, variety and detail make it less amendable, even resistive to man's direct efforts to control and/or alter environmental behavior. The model is used as an interface between man and the environment. If the model is an appropriate re-casting of the environment's essential behavior then man's chances for ultimately exerting control over the environment are enhanced considerably. Models may be highly abstract, highly philosophical on the one hand, or highly concrete and material on the other. As the model is refined and understood, man sets about to fashion tools and/or machines on the basis of information gleaned from studying the behavior of the model. These aids are designed to monitor automatically the behavior of the environment, recognize its regularities and finally exert control over it. Ultimately man's tools and machines serve the functions of arresting or constraining forces external to himself for the purpose of preserving and storing excess energy and information. The end is to use the environment's structure and dynamics to satisfy ends already predetermined by man as desirable.

The adequacy of these models and the accuracy of the

information they produce about the environment is constantly challenged. Daily, man encounters the problems of adjustment to habitat. In one way or another, he faces the issues of subsistence, persistence, protection from others and from the environment. This activity is engaged in under the most arduous conditions. For the most part, the environment is extremely complex, ever changing, and largely untamed. In a word,-- it is very difficult to model. Tomorrow holds only uncertainty; today is probably a precursor of tomorrow but its revelations come discretely and faintly, yielding only very begrudgingly clues about the future. Yesterday, for all of its importance, for all of the learning, is only dimly recalled, and even then, in distorted form. To compound the dilemma further, man's own sense of presence, his own self-aware existence interferes with filtering from time (i.e., from history) and from the environment the necessary information and energy he needs to subsist and persist meaningfully.

To adjust, to adapt, to cope with the environment, man is obliged to watch it carefully, encoding its variability and recording its regularities. The most intelligent behavior of man is to classify and arrange these regularities into information about tomorrow. Man guards himself against tomorrow's uncertainty by calling out of the past principles of regularity and patterns which portend the nature of the future. He anticipates the future partially to reduce his insecurity about it, partially to upgrade the quality of his present existence, and partially to protect himself against foreboding ruin. He must be prepared for, and braced against, future contingencies both good and bad. If tomorrow threatens either the continuance or quality of life then man is best served if his sentinel system has already alerted him to such a prospect.

It is reasonable enough to assert that man needs to monitor, model, and mold the environment if he wants to enjoy the advantages of a designed, purposive existence. In those environments where rates of change are genuinely slow; variety is restricted; repetitive behavior is easily recognized and recorded; -- the principles and procedures for monitoring, modelling and molding are straight-forward and effective. But where inverse conditions prevail, these tasks are not easily resolved. In environments, such as the international environment--where changes are rapid, variety unrestrained, repetitive behavior disguised--monitoring systems are time consuming, inaccurate and confusing. Models are overly simple and deceiving. Molding is unworkable, even impossible. Few guidelines exist for such environments. To both the most casual observer and the most systematic

student, the international environment seems the classic example of complexity, rapid change, incessant variety, time-delayed cause, constant fluctuation, and discrete, idiographic events. Its variety appears infinite. It has few, if any, recognized points of control. It operates on principles of universal sovereignty, self-determination and independence; it pits the immovable object against the irresistible force.

In the broadest sense, the principles and procedures presented here deal with the question of how to monitor the international environment. Basically the inquiry is to determine whether information can be drawn from the daily flow of international events, and encoded into patterns of repetitive behavior which clue the future, especially when that future is potentially ruinous. Theoretically systems theory and cybernetics constitute a solid foundation for this inquiry, both its design and analysis. Methodological guidelines are provided by the event data and simulations approaches to international relations. These theoretical and methodological approaches are combined to expedite the search for "situational threats" in the international environment. Situational threat, as distinct from an "issued threat," refers to a state of affairs in the international environment which implicitly portends a coming state of disaster or ruin. This state of affairs is neither clearly "announced" nor "declared," as in the case of the issued threat, but is inherent in the unfolding sequence of affairs between states. It is subtle and finely-spun into the totality of international interaction. The task is to filter out those indicators which alert the sentinel system to future calamity. The idea is to recognize and analyze a situational threat before conditions become discommoding.

The Design: Research Questions and Considerations

The design and questions discussed in this research are dependent on several theoretical insights and interests suggested in the work already completed during the first year of TR&A (Threat Recognition and Analysis Project), and in the proposal for the second and third years of financial support by ARPA. (McClelland, 1973; McClelland, 1974; Ramsey, 1974; Martin, 1974)

The key feature of all of this work is the recognition of threats. As Ramsey (1973) and Druckman (1973) have pointed out in their reviews, considerable empirical work has already been conducted by social psychologists on threats. This research, though an invaluable source of information, is primarily confined to what McClelland has described as only one of the two faces of situational

threats, namely the subjective, image, pre-vision side. (McClelland, 1974:7) This research is further restricted because it is often solely concerned with issued threats and not situational threats at all.

The other face of situational threats, i.e., the objective side, has, with the possible exception of the military dimension, been somewhat neglected. The reasons for this neglect are multiple and need not be explicated here, but it may be said with some confidence that (1) the definition of threat has long been restricted to common sense specification and/or to "issued" threats, and (2) few methodologies exist specifically to monitor non-military situational threats as they move dynamically through successive states of "undesirability." This research attempts to expand the concept of situational threat and explore the overarching question of how to monitor international threat systems. In sum, its general theoretical and empirical objectives are to focus on the subjective and objective dimensions of situational threats, and to develop and test methodologies for monitoring the change steps of threat processes.

The design procedures adopted to achieve these ends are: (1) to construct a synthetic determinate international event future; (2) to inlay that future with situational threats; (3) to present that synthetic, inherently threatening future to three experimental subjects (Ss) in a simulated form; (4) to permit interaction and communication between the experimental subjects which can affect, even alter, the strictly determinate path of the international future; (5) to employ both systems and cybernetic notions to construct the future and to analyze the subjects' responses to the event sequence and to one another; and, (6) to capitalize on a number of social psychological strategies to identify the subjective aspects of recognizing and responding to situational threats. The event data approach is used as a model of the international environment and the data it generates can be used to reconstruct a simulated, synthetic international future. (McClelland, 1973a) Notions of systems and cybernetics serve to fabricate and analyze the event-interaction sequences. An interactive, terminal-oriented computer program (written in PL/1) will: (1) present the synthetic future to the subjects; (2) transmit and record all their communications; (3) record all protocols; (4) calculate all systemic impact values and allocate new event-interaction futures; (5) provide tabular and time-series information to the subjects at their request; and, (6) record for future analysis all pattern changes in the simulation. Also, personality profiles will

be established (using the California Personality Inventory) for all of the experimental subjects, and observations will be made periodically throughout the simulation to measure their perceptions of the flow of international events and their opinions of the other subjects' behavior.

The intent of this procedure is to answer a battery of questions. How and when do subjects in a man-machine simulation of the flow of international events recognize situational threats? Which incidences are categorized as potentially ruinous and which are not? When and under what circumstances do subjects act to alter the dynamics of a situational threat? How will they act to affect one another's perceptions of the synthetic future and their behavior toward it? If a negotiation period commences, what are the step change sequences in the bargaining process? What type of an arrangement, if any, is achieved and under what circumstances? What are the perceptions subjects hold of the event flow and of any situational threats in the flow? What are the subjects' perceptions of each other's strategies during normal event-interaction, communication and negotiation periods? What is the relationship between the subjects' personality structure and (1) the acts they undertake to avert states of future undesirability, (2) their recognition of situational threats, and (3) their perception of the event flow and the other participants' behavior? This battery of questions constitutes a formidable group any one of which could be independently investigated. But in a man-machine simulation where the analyst has the advantage of a higher degree of control than he might have in a field study for example, it is possible to permit and handle this level of complexity. Furthermore, these questions are based on the assumption that the answers are constantly changing as the synthetic future is unfolded. Cybernetics, as a method for the analysis of complex systems, is designed to handle both the complexity and change this situation creates. It uses the difference (i.e., the change) of one state from its preceeding state as the basic unit of cybernetic inquiry. The principles of cybernetics inherent in the design and analysis of this simulated, synthetic threat system (referred to as the Threat Recognition and Analysis Simulated System, or TRASS) treat the recognition that one state of TRASS is different than another, or has changed into another state, as the most fundamental analytic construct. Whether experimental subjects can recognize change, especially when the difference between one state and its successive states reflects deterioration, and if they can, "when", is the crux of the inquiry.

Though multiple and complex, these questions cover four issue clusters of extreme importance to the systemic, change step analysis intended by the study. These issue clusters are: (1) can experimental subjects read a stream of international event-interactions which model a synthetic, futuristic international environment, and recognize the situational threats inherent in that stream of events; (2) if the Ss recognize a situational threat, what steps do they take to avert the foreboding ruin they anticipate; (3) what are their perceptions of the event stream, of their own behavioral responses to that stream, and of the other participants' behavior in the simulation, and (4) what changes occur in recognition, response and perception during the entire process? This latter cluster includes valuable information about the learning, behavioral modification and changes in perception which will be experienced during the simulation.

TRASS: The Procedure

The theoretically important question in this study is to determine how, when and under what circumstances participants in a man-machine simulation recognize potentially ruinous event-interaction patterns, and what steps they take to avoid disasterous outcomes. All of the other research questions mentioned above are generated from this initial one. Some important design considerations are: (1) the need for subjects to monitor a fairly complex, though manageable, international environment; (2) the need to employ a model of that environment rather than attempt to deal with the environment directly; (3) the model should generate data for an international environment which resemble the world of diplomacy and high politics more closely than what has been the case in other man simulations; (4) the Ss should be able to affect the pattern of event-interaction through their own acts and stave off a threatening condition they deem undesirable; (5) the Ss should not be permitted the luxury of immediate feedback as to how and when their behavior affected the stream of events; (6) the entire simulation should be laden with qualities of dynamic change, that is, the system should always be in a constant state of flux; and, (7) Ss should be permitted a full range of action-interaction behavior in their efforts to alter a pattern they identify as potentially ruinous.

The man-machine simulation consists of ten three-person experimental groups which are assigned the task of monitoring the event-interaction of an international system consisting of twelve actors. The event-interaction sequence

they will monitor is synthetically constructed and represents two years of future interactive behavior for these actors. As the future is synthetic, it is constructed to conform to a predetermined path specified by the analyst. Intervals of the future event-interactions are presented to the subjects who themselves represent one of the major actors in the system. The subjects assume the roles of special political-military "watch-officers" whose responsibilities are to track the behavior of the system and initiate any acts they deem necessary to protect the nation they represent from undesirable conditions. The determination of an undesirable state is left to the individual subject's discretion. The subjects will be instructed to draw on their own familiarity with international affairs, and the fact that the synthetic future's first day is "tomorrow," to give context to their country's national interests. Each subject will be aided by the fact that he represents one of the three superpowers,--the United States, the Soviet Union or China. It will be of constant interest to the analyst to know how a subject defines his interests and what an undesirable state is. These data will be obtained through periodic PROBES and the information stored for future analysis.

Each subject interacts with the others and with the synthetic history via an interactive PL/1 program at one of three remote terminals. At these stations all of the necessary communication can be conducted effectively. The terminals will receive the following: the different intervals of synthetic international interaction; all event-interaction between the experimental subjects; all their negotiations; and, all tabular and time-series displays of the data requested by the participants to help them in their recognition of the state of the system. An interval of future interaction is presented chronologically to the subjects. The form of this future conforms to the standard event-interaction format: who does what to whom. The interval can be interrupted at any time by any participant. These interrupts allow the experimental subjects to affect the synthetic system by their own efforts. They may be unilateral, bilateral or multilateral in character; they may involve singular acts, or an action-reaction sequence.

As stated previously, the purpose of this study is to determine if Ss in a simulation using synthetic data can recognize a situational threat, and if so, can or will they act to stave off the undesirable conditions forecasted by those situational threats? The subjects' recognition of the state of the system and their event-interaction are,

therefore, the principal elements in the formula to alter the determinate path of TRASS. Ideally, subjects will recognize the situational threats and act collectively to change the system's determinate course. This, if done consistently throughout the simulation, would produce a simulated, synthetic future which is always in a steady state. Such a task would be terribly demanding. It would require high consensus among the subjects over the state of the system, the means needed to maintain a particular state, and the desirability of doing so. Less ideally, the subjects will either not recognize the different states of the system or they will disagree about it. Furthermore, their event-interaction will not be "sufficient" to alter the determinate path of TRASS.

The range of political, diplomatic, economic and military event-interaction available to the Ss is described by the WEIS event codes (See Appendix A). To determine whether the Ss have altered the determinate course of TRASS, a formula exists which calculates the subjects' systemic impact on the simulated future. Systemic impacts are computed automatically at the end of each interval of future. An interval is a varying length of time, but generally it ranges from 6 to 14 days. The values of the systemic impact determine if the system is constrained, unaffected or accelerated. (See Figures 1-5) If the value is sufficient to constrain the system, then the next interval of future is less threatening and will, if maintained, eventually return the system to its steady state. Exactly how and when the system is returned depends on what state it is in and what the interval is. The systemic impact value may also act to accelerate a state of the system. Figure 1 Steady State of TRASS and its Lines of Constraint and Acceleration shows the determinate steady state trajectory and its alternative paths of acceleration and constraint. The high acceleration line describes a path where the systemic impact values were unduly conflictual and prematurely terminated the steady state of the system.

Subjects are unaware of the end of intervals or that a systemic impact (SI) value is calculated at that time; nevertheless, the next interval of future depends on this calculation. The SI formula is:

SI=(Protocols/No. of Event-Interactions) + RSS

where Protocol is the numerical value of the event-interaction between the subjects during the interval (See Table 1 and 2); and, RSS is recognition of the state of the system.

The term "protocol" is used to describe the form and sequence of event-interaction behavior between the experimental subjects. A protocol is a record of the input-output behavior of the subjects. Ashby has used the term protocol in this way, and its adoption here conforms with his definitions and uses. (Ashby, 1956:88) The protocol is used to track the event-interaction behavior of the Ss and isolate its impact on the dynamics of the simulated future. An example of a protocol is:

The Protocol (over time)

Time	Input	Output	No. of Event-Interaction
1	S1 accuses S2;	S2 denies S1	1
2	S2 warns S1 ;	S1 threatens S2	1

The importance of the protocol is that it weighs the influence of the input-output behavior of the subjects, over time, on the simulated future. The numerical value for this protocol is done automatically by the program by using Tables 1 and 2 as look-up matrices. The protocol values for the example above are:

(Input,Output)	=	Protocol value
(Accuse,Deny)	=	2.740
(Warns,Threatens)	=	2.495

The protocol values in Tables 1 and 2 were generated by using a modification of Calhoun's friendly-hostile scale of the event codes. Using Osgood's semantic differential technique, Calhoun constructed a conflict scale based on judges' subjective ratings of each item along a friendly-hostile dimension and the arithmetic distances between each event (the latter being achieved through the use of n-dimensional geometric techniques). (Calhoun, 1971a; Calhoun, 1971b) A constant of +5 was added to each of Calhoun's values to eliminate the negative values for convenience for processing. The actual values were computed by adding the scale values for two event codes, e.g. accuse and deny at 2.347 and 3.134 respectively, and dividing by 2. The resultant, 2.740 in the example, then is a function of symmetrical interactive effect of the two event scale scores on one another. The protocol values in Table 2 are the inverse of those in Table 1 The Normal Protocol Values. The difference is because TRASS allows for the use of conflictual event-interaction to constrain TRASS under

certain conditions (See Appendix B).

RSS, or recognition of the State of the System, is a subjective response by each of the respondents. There are objective measures of recognition in TRASS but they will be used in the analytic procedures and not in determining the systemic impact values. The first task at the beginning of each evaluation interrupt is for the subjects to REPORT: (1) the current trend (state) of the system, (2) how long the system is expected to follow this trend (3) a short term subjective prediction of where the system is headed(2-6 days), and (4) a long term prediction (one week or more). The subjects will be provided a list of key words and adjectives they may use to describe the system. Each key word will describe one and only one state of the system. For example when describing a trend or state of the system, the words "downward" and "upward" would refer to the downward diagonal state and the upward diagonal respectively. The PL/1 program scans these trend descriptors and compares them with the actual state of TRASS. Where the descriptor matches the state, the subject is said to have properly identified the state of the system. RSS depends on all three Ss. If all the Ss recognize the systems' state a value of 1.788 is assigned to RSS. Each subject who recognizes the state contributes one-third of 1.788 to RSS. The value 1.788 is equivalent to one standard deviation of the distribution of protocol values. It is an arbitrary value, but since all SI values are transformed to normalized transition values based on the normal distribution of protocol values, the standard deviation seems a legitimate value to use. This procedure translates recognition into a numerical value which can appreciably affect the SI value. Recognition of the system can be an independent matter or the subjects can try to affect one another's perceptions of the system. However, the Ss are not informed about one another's REPORTS nor does the system ever explicitly feed back information about the accuracy of their perceptions. Feedback comes only in the form of the next interval of future.

History, meaning the subjects' past record of response to the simulated future, is also part of the SI calculation; however, it is handled in the Transition Probability Value Tables rather than in the formula itself. Both the most recent past and the traditional responses of the subjects are taken into consideration in the construction of these tables. The guideline for treating history in TRASS is that once a particular trajectory commences it becomes increasingly more difficult to change. History does not, however, lock the subjects into one trajectory from state to state. The role of history is modified by initializing it to

zero at the beginning of each new state. This means that history is very influential during the playing out of a state's trajectory of event-interaction, but the character of that influence is allowed alteration at the beginning of each new state.

Once the SI value is calculated, the range is .956 to 9.343, it is normalized and transformed to a value between .00 and 1.00. This normalized value is referred to as the transition value. It is actually the transition value which is passed through a filter, known here as a quantizer, and a decision made about which module of synthetic future will be allocated for the next interval of future. (For a discussion of quantizer circuits see Papoulis, 1965: 122) The quantizer is designed to test the transition value against the probabilities associated with accelerating, constraining, or not affecting the system's determinacy.

At this point, an understanding of the actual mechanics of the simulation would best be served by looking at Figure 1 and reading through the following steps.

Step 1:

A pool of thirty experimental subjects is selected, tested for personality profiles and socio-economic backgrounds, trained to understand event data information, both in tabular and time series form, and instructed relative to the simulation exercise.

Step 2:

At each simulation session, three subjects are positioned at separate, remote terminal stations (along with a terminal operator) where information will be both received and transmitted.

Step 3:

Once in place, TRASS will simultaneously commence transmitting daily event-interaction records of the twelve actor system under inspection.

Step 4:

If at any time during this transmission one or more of the subjects wishes to interrupt the session, TRASS will terminate its futures input feed and process any event-interaction between the subjects.

This event-interaction is recorded for processing during the simulation (that is in the construction of protocols for the calculation of system impact values), and stored for future analysis after the simulation terminates. (There is an important difference between the processed protocols and the stored protocols: namely that the former is composed of two elements, and the latter consists of three--the character of the input future, the input behavior of one subject, and the output response of another.)

Step 5:

When a time interval ends, an evaluation interrupt is performed. Here, the systemic impact (SI) value is computed and transformed to a normalized transition value ranging from .00 to 1.00. This value is then processed by the quantizer and a decision made as to which module of event-interaction future is allocated next. The decision is based on the probability of moving from the present condition to the next condition.

Step 6:

The new future is then transmitted to the subjects and the process repeats itself until two years of future have elapsed.

Data Management and Analysis

A voluminous amount of data will be generated during this man-machine simulation. The purpose of a highly interactive time-sharing procedure is not only to handle the problems of inter-subject exchange, and futures presentation, but to probe for additional subjective insights, and to record, for future analysis, the entire simulation. The types of data recorded include:

(1) the synthetic future as input, (stimulus) and the subjects' event-interaction as output (response);

(2) the sequence of event-interaction between subjects, (protocol);

(3) the overall interaction behavior of the subjects as a triad;

(4) the form and content of all communication between subjects, especially during negotiations;

(5) the subjective evaluations of the synthetic future (generated in the Reports) and perceptions of the strategies and tactics employed by the subjects (via PROBES during the simulation);

(6) the socio-economic backgrounds of each subject; and,

(7) their personality profiles.

Data items 1-5 are particularly important to the cybernetic analysis. Each is measured over time thereby permitting patterns, and changes in pattern to occur. It is these changes and patterns that cybernetics is designed to analyze. The methods for cybernetic analysis employed here are a modified version of those in Ashby's AN INTRODUCTION TO CYBERNETICS. They are concerned with the recognition of pattern in a determinate system (machine) and transformations from one pattern to another. This type of analysis is, in its strictest form, applicable only to systems which are determinate, where the steady state has known properties, and where changes in the system (i.e., transformations) are closed, and single-valued. A closed transformation is one where every element in the change from one condition to the next was actually present, or inherently present, in the original condition. A single-valued transform exists when an element (an "operand" in Ashby's terminology) changes to one and only one transform. For example in the case of TRASS, if each state is unaltered by the event-interaction of the subjects then the determinate, closed, single-valued transformation of the system is: steady state to upward diagonally to lull to crisis to systemic disturbance to downward trajectory. This transformation may be represented as:

$$T: \downarrow \begin{array}{cccccc} A & B & C & D & E & F \\ B & C & D & E & F & A \end{array}$$

TRASS can, however, be altered. An altered TRASS ceases to be strictly deterministic, and becomes probabilistic. Movement from one condition to another "within" a state of TRASS is a function of probability. One of Ashby's principal arguments in AN INTRODUCTION TO CYBERNETICS is the idea that the procedures for studying change in a determinate, closed, single-valued system can be applied to a probabilistic, non-single-value system.

Should the system not be determinate,

> i.e. the transformation not single-valued, he (the scientist) can proceed in either of two ways.
>
> One way is to alter the set of inputs and outputs--to take more variables into account--and then to see if the new system... is determinate. Thus a chemist may find that a system's behavior is at first not determinate, but that when the presence of traces of chloride is taken into account it becomes determinate. A great deal of research consists of such searches for a suitable set of variables.
>
> A second way is to abandon the attempt to find strict determinacy and to look for statistical determinacy, i.e., determinacy in averages, etc. The experimenter, with extensive records available, then studies them in long sections to see whether, if the details are not predictable from section to section. He may find that the records show the statistical determinateness of the Markov chain...To summarize: once the protocol has been obtained, the system's determinateness can be tested, and (if found determinate) its canonical representation can be deduced. (Ashby, 1956: 90-91)

TRASS, in as much as it is synthetic, has pre-designed properties of determinacy and probability. Whether a state transforms from one state to the next is probabilistic, but the determination of which state the system actually transforms to is determinate. The unconstrained, unaccelerated TRASS transforms thusly: A --> B --> C --> D --> E --> F --> A. A constrained TRASS causes the system to move from whatever state it is in to a new steady state sequence. Once a new steady state is activated, the entire process commences anew. An accelerated TRASS follows the same determinate state transformation trajectory of steady state (a) to an upward diagonal (B) to the lull (c) to a crisis (D) to an absorbing disturbance (E) to a downward trajectory (F), and finally, to a new steady state (A). The difference between an accelerated and a determinate TRASS is the increased speed (in time) at which the accelerated TRASS passes through its states. The probability factor of TRASS allows for the system's equifinality. Conditions within intervals are arrived at probabilistically. As mentioned before, each new interval of future is allocated on the

basis of the probability of moving from one condition within the state to the next as a function of: the protocols, recognition, present condition and past behavior during a particular state of the system.

Variety can be handled in such a system because all of the alternative paths of the system can be defined probabilistically. The bounds of variability are circumscribed and enveloped; the only analytic task is to encode the variety into regular, repetitive behavior and change sequences. One of the major tasks is to demonstrate how cybernetics can be used to provide this information.

The Personality and Perceptual Measures

Much has already been made of the import of personalities in political research. The effect of personality on conflict-cooperation situations has been documented in many different studies. (Terhune, 1968, 1970; Druckman, 1967, 1968; Wrightsman, 1966; Geis, 1964; Beal & Taylor, 1974) The effect of personality is not always a dominant factor (Walton & McKerfie, 1964) but the suggestion made by Beal & Taylor (1974) that a transaction model of the impact of personality on the management of conflict seems to have considerable merit and is worthy of further research. However, the principal reason for identifying the personality structure of experimental subjects is to enrich the information available to the analyst about the subjects in the simulation. Recent psychological studies of prominent political figures have demonstrated that tremendous insights can be gained by knowing in some detail the personalities of prominent decision makers. (Barber, 1968, 1972; Rogow, 1963, 1969; Greenstein, 1969; Greenstein & Lerner, 1971; Mazlish, 1972; Hargrove, 1966)

The critical problem here is to determine what personality variables are really of interest in this particular man-machine simulation. For the moment the idea of a non-projective test, such as the California Psychological Inventory, seems appropriate because such a test is relatively easy to administer and provides an adequate clinical profile of the experimental subjects.

The perception testing, whose importance has also been mentioned previously, is primarily designed to give a time series account of the way Ss view the dynamics of the simulation. Through a battery of questions, the objective is to determine the changes in the Ss view of: 1) the event flow, 2) the situational threat, 3) his own strategy, 4) the strategy of the other subjects, and 5) the goals he ascribes

to himself or to the others. The relationship between the perceptions of one subject, his counterparts, and the analyst's view of the objective features of the simulation will give invaluable clues for determining the characteristics of the threat recognition process. The assumption is made that these perceptions are not static, but have dynamic qualities to them. Constant probes will be made during the simulation to get the "over-time" perception, that is a constantly changing perception of the entire simulation.

Conclusion

TRASS is a highly complex simulation of an international threat system. Its components are by design highly interactive and interdependent. As a simulation of an international threat system, it should be viewed holistically, bearing in mind that to divide it into its component parts would be to commit Beer's error of "divisio." (Beer, 1960) The system can not be understood by arbitrarily dividing it into parts; to do so, would strip its internal dynamics and uniqueness. In a word, it would cease to be TRASS.

The experimental subjects, whose behavior is intertwined with TRASS' high degrees of interrelationship and interdependence, are not confronted with a strict problem-solving exercise. To the contrary, the system requires monitoring and controlling; it has no solution,--it only has change. Control, regulation and monitoring are the only tasks the subjects have. Control of TRASS, the subjects ultimate objective, means to constrain the system from ending in disaster. Such control is exerted through behavior and not by switches. And the more time that elapses in the simulation, the more TRASS becomes "infested" with the behavioral inputs of the experimental subjects; consequently, the longer they monitor and interact with the system, the more they are actually looking at themselves. The degree to which TRASS is self-regulating is dependent on the degree to which the subjects exert restraint on their own behavior.

TRASS, as a simulated international threat system, makes no pretext of having a real world referent. It is, however, based on a set of assumptions which could be comfortably ascribed to some states of the international system. These assumptions are numerous, but would include the following assertions.

(1) The arrangement of nation-state actors reflects a high degree of inter-depenaence and

inter-relationship.

(2) The arrangement of actors can be meaningfully described as a "system" and using the concepts of systems theory. (Beal, 1974)

(3) The international system periodically experiences conditions which can be treated as "situationally threatening" to one or all of the actors in the system.

(4) An international threat system will in all likelihood, not emerge "ex nihilo," but will evolve out of a context of antagonism and conflict.

(5) It is reasonable to suggest these antagonisms will emit signals or warnings which can be detected by a careful observer with special skills.

(6) An international threat system has a dynamic all its own, and once permitted to unfold, will, if unabated, terminate in ruin for all concerned.

(7) There are no well recognized "switches" which can be thrown to control or regulate an international threat system; and there is no recognized authority responsible for control.

(8) It is, however, possible to control or restrain an international threat system.

(9) Control is really exerted only through the behavior of actors in the system.

(10) Feedback containing information about how the behavior actually affects the system comes only in the form of future behavior of the system.

(11) Therefore actors are forced to comb out "information" about how their behavior affects the system.

(12) The more actors attempt to exert control over an international threat system, then the more they are looking at themselves and their own behavior in the stream of future international events.

(13) The most frequent outward manifestations of an international threat system is incessant variety and constant change.

(14) There is pattern in the variety however; the problem is to encode the system's output in such a way as to isolate patterns and changes from one pattern to another. Pattern is assumed because without repetitive behavior of some sort there is no possibility whatsoever of ever understanding the system.

(15) Change is the most important empirical measure and analytic construct for an international threat system, or for any system.

(16) No scenario of events is known, and no guides exist to singularize the attention of the participants on the principal components and forces in the system. Identification of salient actors, forces, patterns, etc. is always a matter of discovery through monitoring the system over time.

(17) A major task of any actor is to encode the variety and reduce it to a manageable level.

(18) The purposes for monitoring and controlling can be highly variable, complex and changing. But they are invariably connected in the final analysis with stability, the state of least stress, and survival, the state of maximum physiological order.

These assumptions are undoubtedly supported by a set of yet implicit assumptions about the science of international relations, methodology, causality and other relevant matters; these eighteen form only the conscious list used in TRASS as it now stands.

One final point remains: why study an international threat system from a cybernetic, synthetic simulation perspective? What is accomplished through such an exercise? The reasons for "non-data" dependent simulations have been advanced by many others and need not be restated here. The reasons for a synthetic data base, or what might be called a scenario-free simulation, is a new concept and suggests how the event data approach can be used to augment simulation exercises. On this point, McClelland has already commented

that:

> Event simulations carry the promise of facilitating the analysis of possible futures just as the scenario-centered gaming exercises have done. They differ from the latter in just a few basic respects: (1) they bring a larger volume of projected data into use, (2) they utilize to a far greater extent computerized files and data management, selection, and retrieval procedures, (3) they emphasize more heavily the processes through which international system changes occur, (4) they impose heavier requirements of analysis and decisional judgment on the participants in gaming exercises and (5) they modify and sometimes eliminate the adversary format -- of team playing against team that scenario-centered political-military games have most often featured. Despite these differences, it should be emphasized that event simulation is not a movement directed at the destruction of scenario-centered exercises. (McClelland, 1973a: 2)

A synthetic event simulation offers an alternative approach to scenario-based simulations. A new challenge is created for experimental subjects in an event simulation where they must decide what is threatening about the flow of international behavior rather than being told what the problem is. Crisis management becomes broader, and in a sense more realistic, because participants must first recognize a situational threat before they can act to control it. Furthermore, the participants' attempts at control in the simulation are absorbed into the total behavior of the system rather than isolated and treated as distinct in some way. The system responds dynamically rather than statically to the participants. Their attempts at control are swept up into the unfolding future giving them a past, present and future context. Participants are not permitted the luxury of knowing exactly how their behavior affects the system, or the time to weigh all of the information, or to have total "interactive control" over the outcome of the crisis. A more meaningful range of alternative outcomes with more decision points is possible in a synthetic event future than in a scernario-dependent

simulation.

The cybernetic design, construction, execution and analysis of the synthetic simulation grounds the procedure on a set of assumptions which are common to each state of the procedure. Feedback, self-regulation, control, recognition, equifinality, high interdependence, high complexity, high variety are interwoven into each step of the exercise. What is totally free to vary with each group of experimental subjects are the patterns of repetitive behavior and the changes from one pattern to the other. It is pattern and change that the cybernetic approach is constructed to isolate and analyze. Once the procedures for accomplishing the cybernetic analysis of a synthetic international threat system are understood, then a major step will have been taken toward applying such procedures to a real system.

TABLE 1. NORMAL PROTOCOL VALUES FOR ALL STATES OF TRASS.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	8.387	8.167	8.083	7.977	7.952	7.950	7.314	7.202	7.053	6.747	6.158	5.859	5.790	5.760	5.702	5.367	5.251	5.162	5.103	5.022	4.942	4.671
2		7.947	7.863	7.756	7.732	7.730	7.094	6.982	6.833	6.527	5.938	5.639	5.570	5.540	5.482	5.147	5.031	4.942	4.883	4.802	4.722	4.451
3			7.780	7.674	7.649	7.647	7.010	6.899	6.750	6.444	5.855	5.555	5.486	5.457	5.399	5.063	4.948	4.859	4.799	4.719	4.719	4.368
4				7.568	7.543	7.541	6.904	6.793	6.644	6.338	5.749	5.450	5.380	5.351	5.293	4.957	4.842	4.753	4.693	4.613	4.532	4.262
5					7.518	7.516	6.879	6.768	6.619	6.313	5.724	5.425	5.355	5.326	5.268	4.932	4.817	4.728	4.668	4.588	4.507	4.237
6						7.514	6.877	6.766	6.617	6.311	5.722	5.423	5.353	5.324	5.266	4.930	4.815	4.726	4.666	4.586	4.505	4.235
7							6.241	6.195	5.980	5.674	5.085	4.736	4.717	4.687	4.629	4.294	4.178	4.089	4.030	3.949	3.869	3.598
8								6.018	5.869	5.563	4.974	4.675	4.605	4.576	4.518	4.182	4.067	3.978	3.918	3.838	3.757	3.487
9									5.720	5.414	4.825	4.526	4.456	4.427	4.369	4.033	3.918	3.829	3.769	3.689	3.608	3.338
10										5.108	4.519	4.220	4.150	4.121	4.063	3.727	3.612	3.523	3.463	3.383	3.330	3.032
11											3.930	3.631	3.561	3.532	3.474	3.138	3.023	2.934	2.874	2.794	2.713	2.443
12												3.332	3.262	3.233	3.175	2.839	2.724	2.635	2.575	2.495	2.414	2.144
13													3.193	3.163	3.105	2.770	2.654	2.565	2.506	2.425	2.345	2.074
14														3.134	3.076	2.740	2.625	2.536	2.476	2.396	2.315	2.045
15															3.018	2.682	2.567	2.478	2.418	2.338	2.259	1.987
16																2.347	2.231	2.142	2.083	2.002	1.922	1.651
17																	2.116	2.027	1.967	1.837	1.806	1.536
18																		1.938	1.878	1.798	1.717	1.447
19																			1.819	1.738	1.658	1.387
20																				1.658	1.537	1.307
21																					1.497	1.226
22																						.956

TABLE 2. INVERTED PROTOCOL VALUES FOR ALL STATES OF TRASS.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1	.956																					
2	1.226	1.497																				
3	1.307	1.537	1.658																			
4	1.387	1.658	1.738	1.819																		
5	1.447	1.717	1.798	1.878	1.938																	
6	1.536	1.806	1.887	1.967	2.027	2.116																
7	1.651	1.922	2.002	2.083	2.142	2.231	2.347															
8	1.987	2.259	2.333	2.418	2.478	2.567	2.682	3.018														
9	2.045	2.315	2.396	2.476	2.536	2.625	2.740	3.076	3.134													
10	2.074	2.345	2.425	2.506	2.565	2.654	2.770	3.105	3.163	3.193												
11	2.144	2.414	2.495	2.575	2.635	2.724	2.839	3.175	3.233	3.262	3.332											
12	2.443	2.713	2.794	2.874	2.934	3.023	3.138	3.474	3.532	3.561	3.631	3.930										
13	3.032	3.330	3.383	3.463	3.523	3.612	3.727	4.063	4.121	4.150	4.220	4.519	5.108									
14	3.338	3.608	3.689	3.769	3.829	3.916	4.033	4.369	4.427	4.456	4.526	4.825	5.414	5.720								
15	3.487	3.757	3.838	3.918	3.978	4.067	4.182	4.518	4.576	4.605	4.675	4.974	5.563	5.869	6.018							
16	3.598	3.869	3.949	4.030	4.089	4.178	4.294	4.629	4.687	4.717	4.786	5.085	5.674	5.980	6.195	6.241						
17	4.235	4.505	4.586	4.666	4.726	4.815	4.930	5.266	5.324	5.353	5.423	5.722	6.311	6.617	6.766	6.877	7.514					
18	4.237	4.507	4.588	4.668	4.728	4.817	4.932	5.268	5.326	5.355	5.425	5.724	6.313	6.619	6.768	6.879	7.516	7.518				
19	4.262	4.532	4.613	4.693	4.753	4.842	4.957	5.293	5.351	5.380	5.450	5.749	6.338	6.644	6.793	6.904	7.541	7.543	7.568			
20	4.368	4.719	4.719	4.799	4.859	4.948	5.063	5.399	5.457	5.486	5.555	5.855	6.444	6.750	6.899	7.010	7.647	7.649	7.674	7.780		
21	4.451	4.722	4.802	4.883	4.942	5.031	5.147	5.482	5.540	5.570	5.639	5.938	6.527	6.833	6.982	7.094	7.730	7.732	7.756	7.863	7.947	
22	4.671	4.942	5.022	5.103	5.162	5.251	5.367	5.702	5.760	5.790	5.859	6.158	6.747	7.053	7.202	7.314	7.950	7.952	7.977	8.083	8.167	8.387

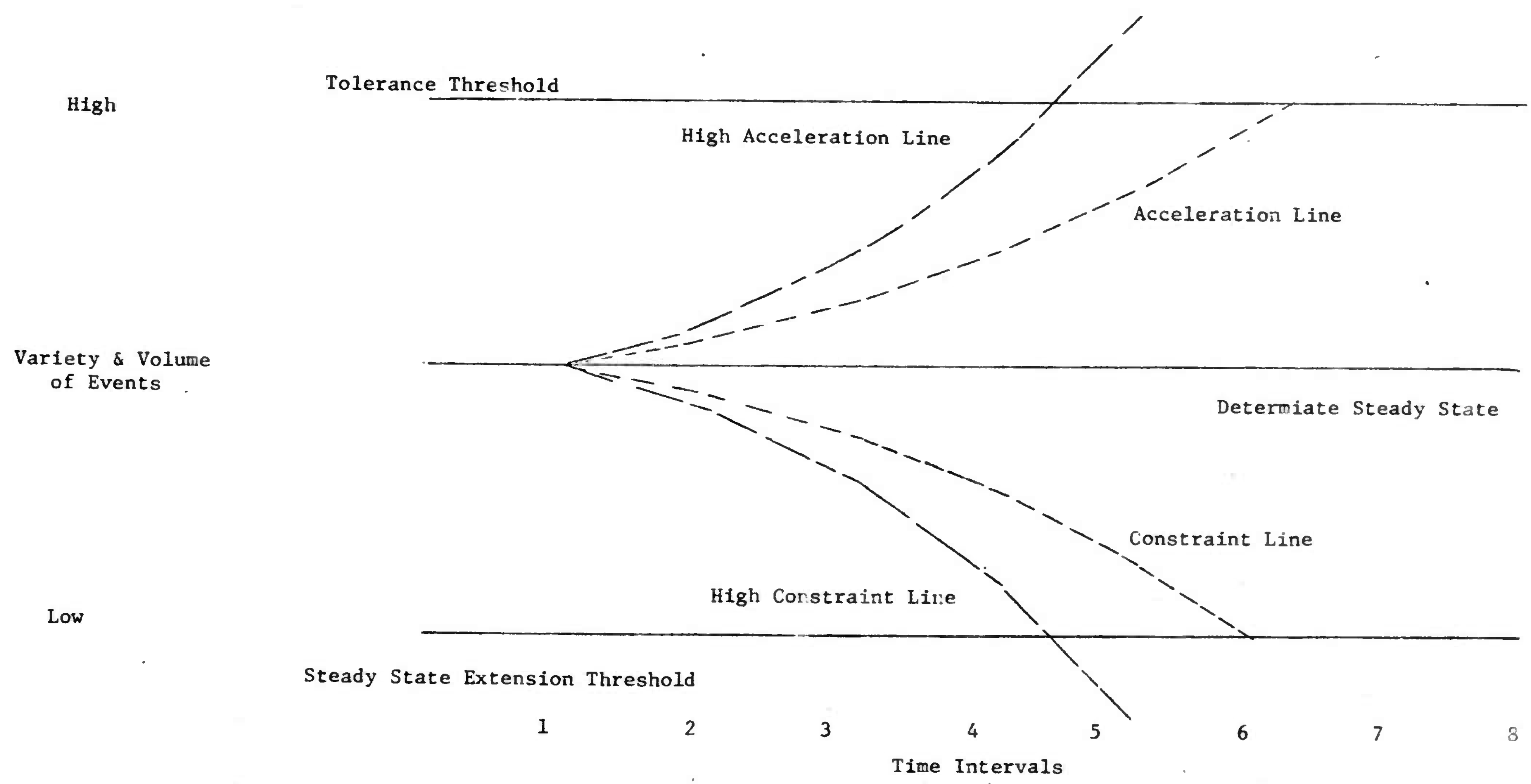

Figure 1. Steady State of TRASS and its Liens of Constraint and Acceleration.

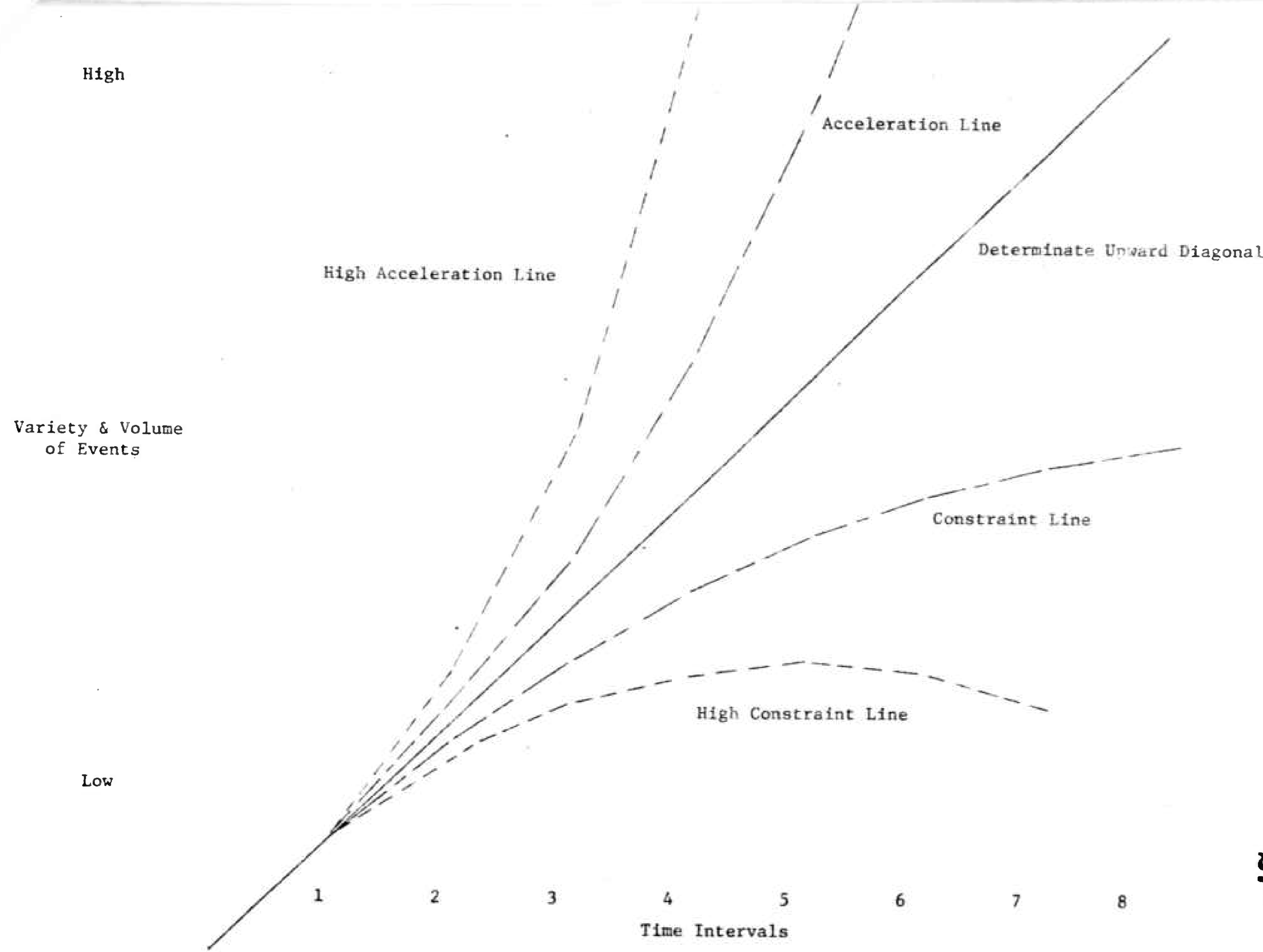

Figure 2. Upward Trajectory of TRASS, and its Lines of Constraint and Acceleration.

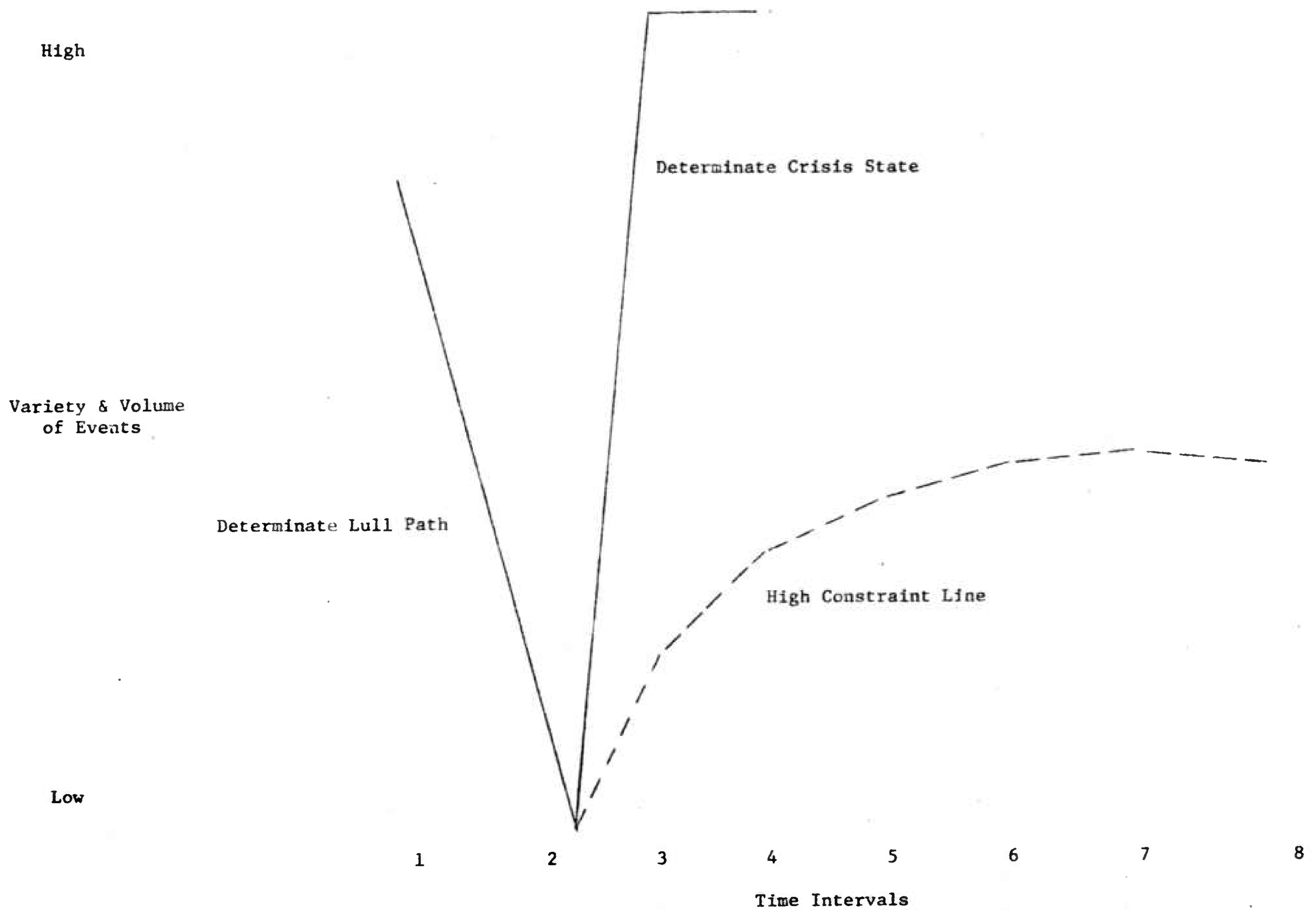

Figure 3. Lull and Crisis States of TRASS and its High Constraint Line.

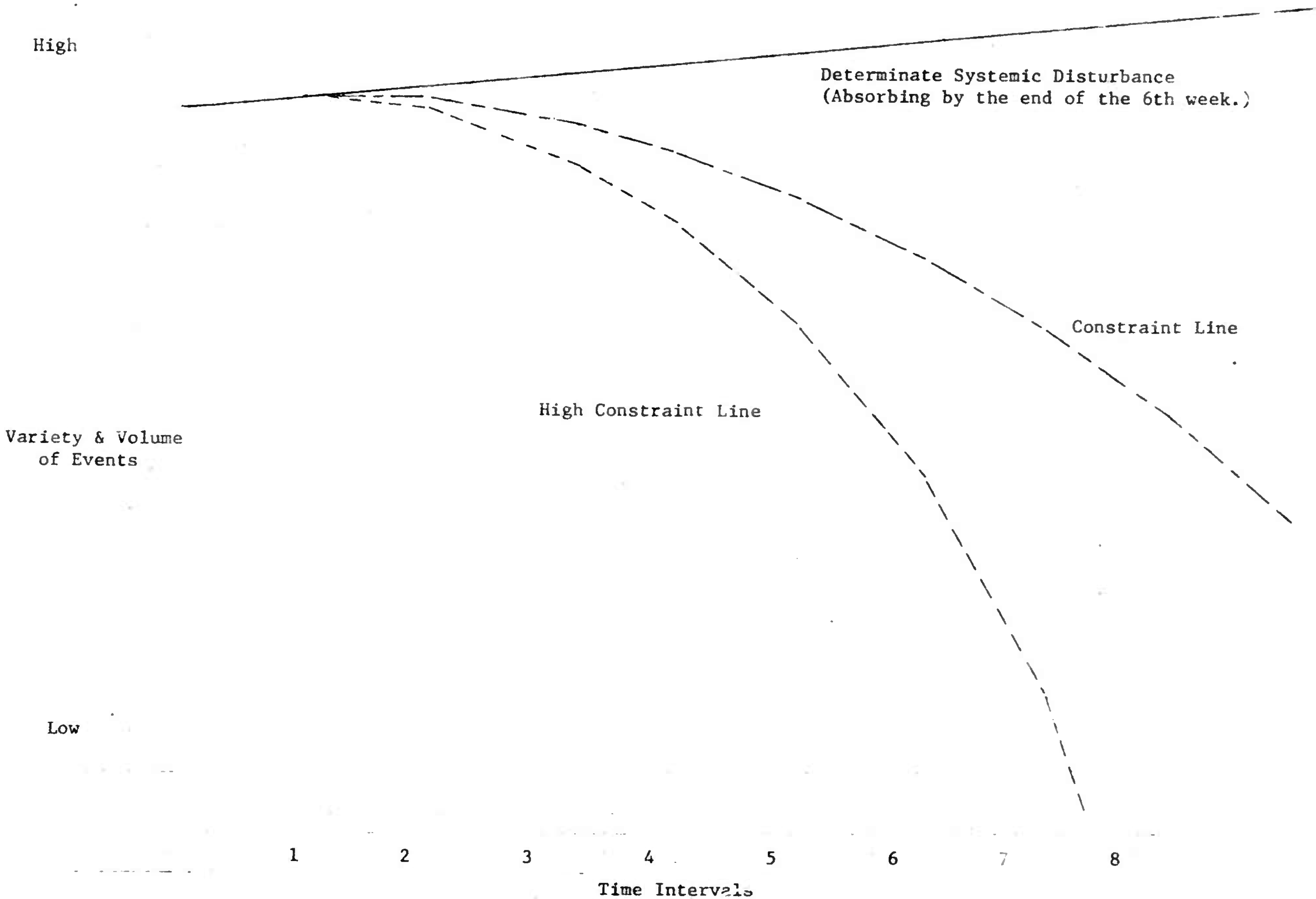

Figure 4. Systemic Disturbance of TRASS and its Constraint Lines.

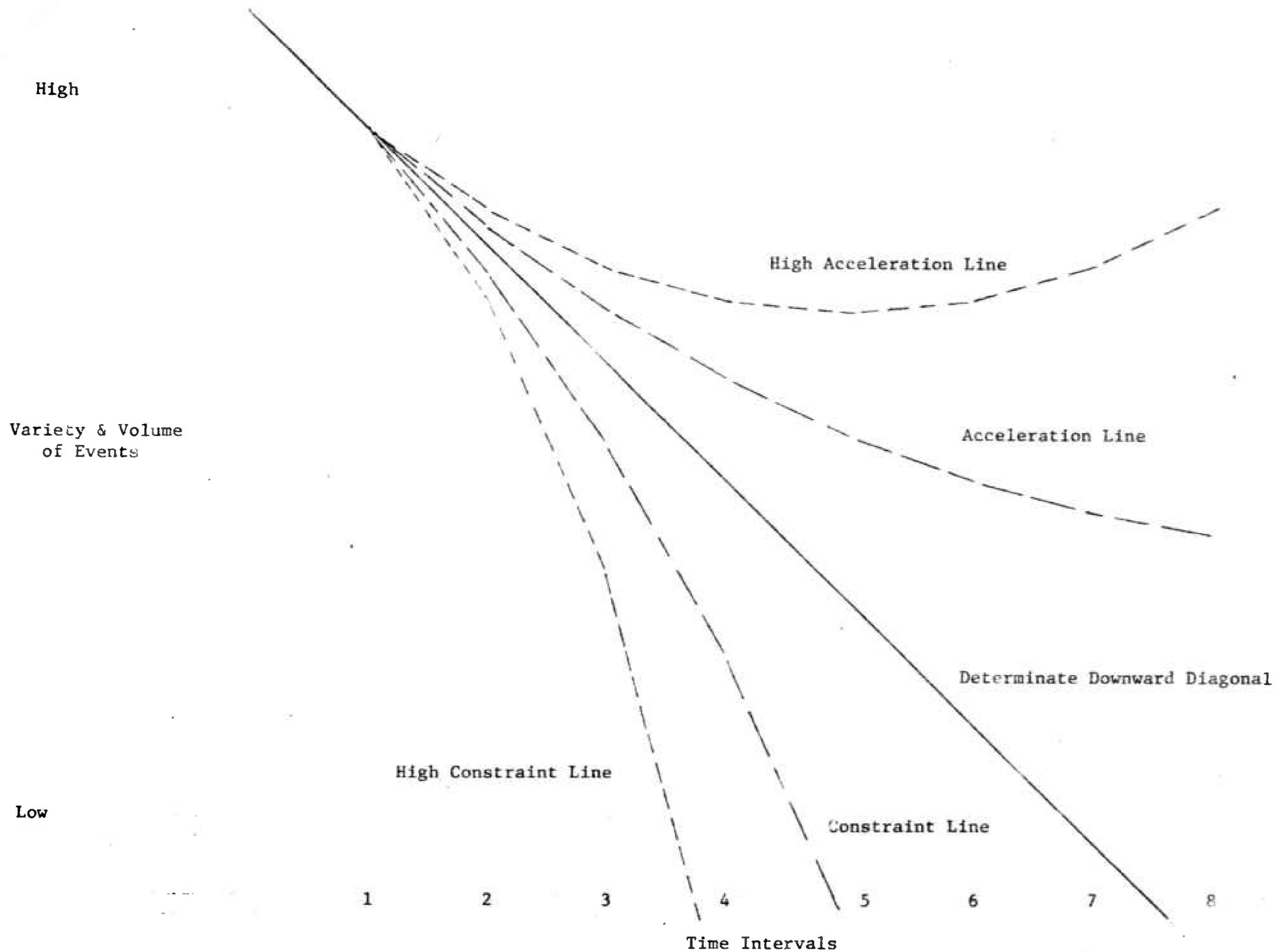

Figure 5. Downward Trajectory State of TRASS and its Lines of Acceleration and Constraint.

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APPENDIX A
EVENT CODES

1. YIELD

   011 Surrender, yield to order, submit to arrest, etc.
   012 Yield position; retreat; evacuate
   013 Admit wrongdoing; retract statement

2. COMMENT

   021 Explicit decline to comment
   023 Comment on situation--neutral, hope, express concern

3. CONSULT

   031 Meet with, at neutral site; or send note, staying in same place
   032 Visit; go to; leave country
   033 Receive visit; host

4. APPROVE

   041 Praise; hail; applaud; condolences; ceremonial greetings; thanks
   042 Endorse others policy or position; give verbal support

5. PROMISE

   051 Promise own policy support
   052 Promise material support
   053 Promise other future support action
   054 Assure; reassure

6. GRANT

   061 Express regret; apologize
   062 Give state invitation
   063 Grant asylum

   064 Grant privilege, diplomatic recog nition; de facto relations, etc.

065 Suspend negative sanctions; truce
066 Release and/or return persons or property

7. REWARD

071 Extend economic aid (gift and/or loan)
072 Extend military assistance; joint military exercises
073 Give other assistance

8. AGREE

081 Make substantive agreement
082 Agree to future action or procedure; agree to meet, to negotiate, accept invite

9. REQUEST

091 Ask for information
092 Ask for policy assistance; seek
093 Ask for material assistance
094 Request action; call for; ask for asylum
095 Entreat; plead for; appeal to; help

10. PROPOSE

101 Offer proposal
102 Urge or suggest action or policy

11. REJECT

111 Turn down proposal; reject protest demand, threat, etc.
112 Refuse; oppose; refuse to allow; exclude; fail to reach agreement

12. ACCUSE

121 Charge; criticize; blame; disapprove
122 Denounce; denigrate; abuse; condemn

13. PROTEST

131 Make complaint (not formal)
132 Make formal complaint or protest

14. DENY

141 Deny an accusation
142 Deny an attributed policy, action, role, or position

15. DEMAND

150 Issue order or command, insist; demand compliance, etc.

16. WARN

160 Give warning

17. THREATEN

171 Threat without specific negative sanctions
172 Threat with specific non-military negative sanctions
173 Threat with force specified
174 Ultimatum; threat with negative sanctions and time limit specified

18. DEMONSTRATE

181 Non-military demonstration; walk out on; boycott
182 Armed force mobilization, exercise, and/or display blockade

19. REDUCE RELATIONSHIP (as Neg. Sanction)

191 Cancel or postpone planned event
192 Reduce routine international activity; recall officials, etc.
193 Reduce or suspend aid or assistance
194 Halt negotiations
195 Break diplomatic relations

20. EXPEL

201 Order personnel out of country; deport
202 Expel organization or group

21. SEIZE

211 Seize position or possessions
212 Detain or arrest person(s)

22. FORCE

221 Non-injury destructive act, bomb with no one hurt
222 Military injury-destruction
223 Military engagement

Appendix B

The Normal and Inverted Protocol Values

The protocol value plays a major role in determining whether TRASS' determinate transformation will play-out. The simple rule for this determinate is: the higher the protocol value, then the higher the probability of constraining the system. The normal and inverted protocol tables are necessary to allow cooperation as well as conflict to constrain TRASS. A system where only cooperative acts constrain would be unrealistic and inappropriate. Conflict protocols constrain TRASS under the following conditions: (1) whenever all three superpowers attempt to constrain the behavior of another actor in the system; (2) whenever two of three superpowers attempt to constrain the aggressive behavior of the third superpower; (3) whenever one superpower acts to constrain any actor in the system and is unopposed by the other superpowers; (4) whenever acts of a conflictual nature are taken by one superpower and unopposed by the other in the upward, crisis or systemic disturbance status to curtail an escalating trend; (5) whenever item(4) is conducted by two of the superpowers and opposed by the third; and, (6) during the last days of the crisis state and last two time intervals of the systemic disturbance state.

Appendix C
The Characteristics of Trass' Six States
The Steady State

1. The steady state of TRASS is its least threatening condition. It is a state where very little stress is present. The system is neither overloaded because of the volume of events nor disrupted by the amount of conflict in the variety mix. Four alternative trajectories to the determinate steady state trajectory exist: high acceleration, acceleration, constraint, and high constraint.

Determinate Steady State Trajectory

2. The determinate steady state trajectory is characterized by a moderate to low volume of event-interaction, and a variety of events which is slightly more cooperative than conflictual. The moving mean volume and proportion of conflictual to cooperative acts remains constant throughout the entire determinate steady state trajectory. Oscillations will of course occur but the volume mean and the variety proportion remain stable.

3. If permitted to play-out, the determinate steady state will last 8 time intervals or approximately 48 days.

4. The steady state's determinate path is a relaxed condition; fluctuations in volume and variety of events do not require adjustment by other elements in the system.

5. The first interval of steady state future can not be changed: this holds true for the first interval of any state.

Constrained Trajectories

6. There are two levels of constraint possible during the steady state: high constraint and constraint. These alternative paths differ in "degree" rather than in kind.

7. Both constrained trajectories reduce the volume of event-interaction in TRASS and reduce the level of conflictual events in the variety mix.

8. The high constraint trajectory terminates the steady state during its fifth future input feed. The constraint path terminates the state at the sixth evaluation interrupt. At these points the "extension threshold" has been encountered and a new steady state is allocated.

Theoretically, the steady state could go on indefinitely.

Accelerated Trajectories

9. The steady state, like other states of TRASS, may be either constrained or accelerated. The accelerated paths, high acceleration and acceleration, prematurely transform the steady state to the upward trajectory state.

10. High acceleration and acceleration differ in "degree" but both have the impact of increasing the volume of event-interaction and the amount of conflict in the variety mix. They have the inverse effect on the system from the constraint lines.

11. A high acceleration trajectory intercepts the tolerance threshold during TRASS' fifth future input feed. At that time the system transforms to its upward trajectory state. The tolerance threshold is not encountered on the acceleration path until the sixth evaluation interrupt.

Upward Trajectory State

1. The upward trajectory state contains TRASS' initital indications of a situational threat. The concept of situational threat has a subjective and objective dimension to it. Subjectively the Ss can perceive a condition to be threatening according to their own criteria for situational threats. Or the subjects themselves may threaten one another. Situational threats may also be generated by the event-interaction of the subjects. The objective situational threat in TRASS is inherent in the volume of events and in the variety. An objective situational threat is operationally defined as an increasing volume of event-interaction over at least two time intervals, and an increasing proportion of conflictual events to cooperative ones.

2. The upward state inherently clues the crisis state.

3. Like the steady state, the upward trajectory has four alternative paths: high acceleration, acceleration, constraint and high constraint.

Determinate Upward Diagonal

4. The determinate upward trajectory is a constantly increasing volume mean. The increases conform to the rates characterized by the diagonal depicted in Figure 2. The proportion of conflict to cooperation also changes.

Proportionately more conflictual acts are present in the latter intervals of future than in the initial ones.

5. If permitted to play-out, the determinate upward state covers eight time intervals.

6. The upward state is a situational threat; its increased volume and proportion of conflict is threatening and its path points to a more ruinous future.

Constrained Trajectories

7. High constraint and constraint, both reduce the volume of events and the proportion of conflict in the event flow.

8. Each reverses the projection of the state and returns the system to a new steady state.

9. High constraint transforms the upward trajectory to a new steady state at the seventh evaluation interrupt. The constraint path transforms the system at the eighth interrupt.

Accelerated Trajectories

10. Both high acceleration and acceleration prematurely transform TRASS to its lull state. The high acceleration path accomplishes this transformation during the fourth future input feed. The transformation occurs at the fifth evaluation interrupt for the acceleration trajectory.

Lull State

1. The lull state is unlike any other state of TRASS. It happens automatically at the end of the upward trajectory or when the tolerance threshold is reached by either of the accelerated paths of the upward state. It can not be constrained or accelerated. It conforms to the empirical observation in many crisis studies that there is a "lull before the storm" phenomena in international relations.

2. The lull state is 6-8 days long and ends with absolutely no event-interaction recorded for the final day. This lull preludes the crisis state of the system.

Crisis State

1. The crisis state is the second most situationally

threatening condition in TRASS. Violence breaks out between selected actors in the system and threatens to embroil all actors.

2. The crisis is generated in approximately two days and lasts from 7-9 days.

3. The state is characterized by a high volume of activity, high proportion of conflictural acts over cooperative ones during the first few days, with a more balanced variety during the last days of the crisis.

Constraint Trajectory

4. The crisis state can only be highly constrained. The experimental subjects must, if they hope to avert a crisis, be able to constrain TRASS consistently (for four time intervals) before the system will return to a new steady state. When the system is constrained one time and not the next, the crisis occurs.

5. The crisis state depicts a highly volatile international condition, and is a precursor of a more encompassing violent entanglement.

Systemic Disturbance State

1. The systemic disturbance follows a crisis. It is characterized by a very high volume of events with a balanced variety in the early stages of the state. Though attempts at cooperation are frequent, resolution of the conflict is not forthcoming. The volume remains high throughout, and eventually the conflictual events dominate the flow of international interaction.

The ultimate condition of this state is total embroilment of all twelve actors in violent conflict. This is the final state of ruin in the system. The all absorbing conflict is achieved by the end of the sixth interval.

Constraint Trajectories

3. Again only constraint is possible in this state. Constraint forces the volume of events down and reduces the amount of conflict in the variety.

4. The constraint paths return the system to a new steady state; high constraint achieves this at the sixth interrupt and constraint at the eighth.

Downward Trajectory State

1. The final state of TRASS is the downward trajectory. Its determinate downward diagonal reduces the volume of events, and balances the variety.

2. Its function is to return the determinate pattern of the system to a steady state.

Downward Diagonal Trajectory

3. This path constantly reduces the mean volume of events along the path described in Figure 5.

4. The state's determinate time duration is 8 intervals.

Constrained Trajectories

5. These constraint trajectories serve the same function as those in other states.

Accelerated Trajectories

6. If the downward state is accelerated an exception to the

$$T: \downarrow \begin{matrix} A & B & C & D & E & F \\ B & C & D & E & F & A \end{matrix}$$

transformation rule is produced. In this case, the steady state is by-passed, and a new upward trajectory commences.

Appendix D

Experimental Subjects

No specific type of subject is desired in this simulation except for the general specification that the subjects be generally aware and sensitive to international relations. This sensitivity will be determined in an interview with those subjects responding to the public advertisement for subjects. Once the thirty subjects are selected, a thorough attempt will be made to identify their socio-economic backgrounds and their personality profiles. The position is taken that a detailed profile of volunteer subjects is more important than pre-selecting a socio-economic or personality type.